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**Student Notes**  
**Science on Saturday**  
***Lawrence Livermore National Laboratory***

February 8, 2014

**Using Big Computers to Understand One of the  
Universe's Biggest Secrets**

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*Dan Burns - Science Teacher - Los Gatos High School*

The most advanced computers in the world are being used to test new ideas for making fusion power a reality. Test your knowledge by circling True or False next to each statement below. Revisit your answers at the end of the presentation to see how you did.

- |   |   |  |
|---|---|--|
| T | F | Fusion is the splitting of atoms into smaller ones.                    |
| T | F | There are only 3 states of matter-solid, liquid, and gas.              |
| T | F | A typical computer can do 50 billion operations per second.            |
| T | F | It would take one computer 30 million years to model a fusion reaction |
| T | F | A 10 Petawatt laser uses as much power as the entire United States.    |
| T | F | LLNL Scientists can model a fusion reaction in 2 hours.                |

Listen carefully to the presentation and answer the questions during the talk.

1. The process that powers a \_\_\_\_\_ can provide us the energy for our future.
2. What 2 kinds of atoms are combined to make helium in the fusion reaction?
3. Why will we need fusion power in the future?

4. List the 3 types of confinement used for fusion reactors (including stars) below:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

5. Why do fusion reactions require high temperatures?

6. What is plasma? Does it react to a magnetic field?

7. Scientists doing fusion research rely on theory, experiments, and

\_\_\_\_\_.

8. To equal the output of 1 computer, everyone on Earth would have to do \_\_\_\_\_ calculations every second.

9. Rank the following from largest to smallest: Human, Cells, Sun, Atom, Fusion Pellet, Earth, DNA, Yosemite Falls.

10. What is the name of the super computer at LLNL? How many processors does it have?

11. Which type of computer modeling (Fluid or Kinetic) is more exact? Which type is faster

12. How did LLNL fusion scientists double the efficiency of fuel heating?

13. Very large \_\_\_\_\_ and complex mathematical \_\_\_\_\_ are needed to understand fusion.



Frederico Fiuza is a Lawrence Postdoctoral Fellow at LLNL. He received his Masters degree in Physics and his PhD degree in Plasma Physics from Instituto Superior Tecnico, Portugal in 2007 and 2012, respectively. Between 2004 and 2012 he conducted his research at the Group of Lasers and Plasmas at IST. During 2009, he was also a visiting scholar at the Plasma Simulation Group (UCLA). He is interested in large-scale simulations of intense laser-plasma interactions, inertial confinement fusion, and laboratory astrophysics.



Dan Burns has been teaching science at Los Gatos High School since 1992. He is currently teaching AP Physics and is the school's technology coach. Dan was selected Educator of the Year at LGHS in 2010. He has served as the president of the Northern California/Nevada section of the American Association of Physics Teachers. He has worked on curriculum development and taught workshops for the SETI Institute, the USGS, NASA, AAPT, and LLNL, just to name a few. Prior to becoming a teacher, Dan was a senior research specialist at the Lockheed Missiles and Space Company where he worked on advanced military and civilian spacecraft.